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| 10/788,656 | 02/27/2004 | Yingjian Chen | K35R1897 | 7261 |

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WESTERN DIGITAL TECHNOLOGIES, INC.
ATTN: SANDRA GENUA
20511 LAKE FOREST DR.
E-118G
LAKE FOREST, CA 92630

| EXAMINER | |
|---|---|
| WATKO, JULIE ANNE | |
| **ART UNIT** | **PAPER NUMBER** |
| 2627 | |

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
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| 3 MONTHS | 01/22/2007 | PAPER |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/788,656 | CHEN ET AL. | |
| | Examiner | Art Unit | |
| | Julie Anne Watko | 2627 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *27 December 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-37 and 40* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *9,10,21,22,33 and 34* is/are allowed.

6)☒ Claim(s) *1-7,13-19,25-31,37 and 40* is/are rejected.

7)☒ Claim(s) *8,11,12,20,23,24,32,35 and 36* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02/27/2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Drawings*

1. The drawings are objected to because of the reasons stated in the office action mailed August 24, 2006. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

2. On page 15 of the response filed December 27, 2006, Applicant states that "Applicant has provided herewith a replacement drawing sheet in which the numbers for the abscissa do not overlap the text." The Examiner has considered this argument thoroughly and asserts that no replacement drawing was received with the December 27, 2006, response. Applicant is advised to include the replacement drawing in the response to this office action.

***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1, 13 and 40 are rejected under 35 U.S.C. 102(e) as being anticipated by Ooshima et al (US Pat. No. 6731479 B2).

As recited in independent claim 1, Ooshima et al show a magnetic sensor (see Fig. 3) comprising: an antiferromagnetic layer 1 extending in a track-width direction; a ferromagnetic layer 2 disposed over the antiferromagnetic layer 1, the ferromagnetic layer 2 having a magnetization that remains substantially fixed ("pinned", see col. 14, line 20) in response to an applied magnetic field and extending in the track-width direction to terminate in a first end; a magnetically soft layer 4 disposed over the ferromagnetic layer 2, the magnetically soft layer 4 having a magnetization that rotates in response to the applied magnetic field ("free", see col. 14, line 23), the magnetically soft layer 4 extending in the track-width direction to terminate in a second end, the first and second ends forming part of a junction; a cap layer 7 disposed over the magnetically soft layer such that the junction has a slope of less than forty-five degrees (see col. 12, lines 60-61, "angle ($\alpha$) between the substrate and the inclined surface of the laminate is 20 to 45 degrees.") when measured at a location seven nanometers below a top of the cap layer; a magnetically hard layer 5 disposed adjacent to at least the second end, the magnetically hard layer 5 having a magnetization (see arrows within 5 in Fig. 3) that remains substantially fixed in

response to the applied magnetic field, to stabilize the magnetization of the end of the magnetically soft layer ("a bias magnetic field can be effectively applied to the free magnetic layer", see col. 14, lines 57-59); and an underlayer 10 disposed between the antiferromagnetic layer 1 and the magnetically hard layer 5.

As recited in claim 13, Ooshima et al show a magnetic sensor (see Fig. 3, for example) comprising: an antiferromagnetic layer 1 extending a first distance in a track-width direction; a ferromagnetic layer 2 disposed over the antiferromagnetic layer 1, the ferromagnetic layer 2 having a magnetization that remains substantially fixed in response to an applied magnetic field; a magnetically soft layer 4 disposed over the ferromagnetic layer, the magnetically soft layer having a magnetization that rotates in response to the applied magnetic field, the magnetically soft layer extending a second distance in the track-width direction, the second distance being not more than half the first distance; a magnetically hard layer 5 disposed adjacent to an end of the magnetically soft layer, the magnetically hard layer 5 having a magnetization that remains substantially fixed in response to the applied magnetic field, to stabilize the magnetization of the end of the magnetically soft layer; and an underlayer 10 disposed between the antiferromagnetic layer and the magnetically hard layer.

As recited in claim 40, Ooshima et al show a magnetic sensor comprising: an antiferromagnetic layer 1 extending in a track-width direction; a ferromagnetic layer 2 disposed over the antiferromagnetic layer, the ferromagnetic layer having a magnetization that remains substantially fixed in response to an applied magnetic field and extending in the track-width direction to terminate in a first end; a magnetically soft layer 4 disposed over the ferromagnetic layer, the magnetically soft layer 4 having a magnetization that rotates in response to the applied

magnetic field, the magnetically soft layer 4 extending in the track-width direction to terminate in a second end, the first and second ends forming part of a junction (see junction in Fig. 3), the junction having a slope of at least twenty and not more than forty degrees (see col. 12, lines 60-61, "angle (α) between the substrate and the inclined surface of the laminate is 20 to 45 degrees.") at the magnetically soft layer; a magnetically hard layer 5 disposed adjacent to at least the second end, the magnetically hard layer 5 having a magnetization that remains substantially fixed in response to the applied magnetic field, to stabilize the magnetization of the end of the magnetically soft layer 4; and an underlayer 10 disposed between the antiferromagnetic layer and the magnetically hard layer.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 2-3, 7, 14-15, 19, 25-27, 31 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ooshima et al (US Pat. No. 6731479 B2).

Ooshima et al show a magnetic sensor as described above.

As recited in independent claim 25, Ooshima et al show a magnetic sensor (see Fig. 3) comprising: an antiferromagnetic layer 1 extending in a track-width direction; a ferromagnetic layer 2 disposed over the antiferromagnetic layer, the ferromagnetic layer 2 having a magnetization that remains substantially fixed in response to an applied magnetic field and extending in the track-width direction; a magnetically soft layer 4 disposed over the ferromagnetic layer 2, the magnetically soft layer having a magnetization that rotates in response to the applied magnetic field, the magnetically soft layer extending in the track-width direction to terminate in an end, the magnetically hard layer 5 having a magnetization that remains substantially fixed in response to the applied magnetic field, to stabilize the magnetization of the end of the magnetically soft layer; and an underlayer 10 disposed between the antiferromagnetic layer and the magnetically hard layer; a magnetically hard layer 5 disposed adjacent to the end.

As recited in independent claim 37, Ooshima et al show a magnetic sensor comprising: an antiferromagnetic layer 1 extending a first distance in a track-width direction; a ferromagnetic pinned layer 2 disposed over the antiferromagnetic layer; a ferromagnetic free layer 4 disposed over the pinned ferromagnetic layer, the free layer having a magnetization that rotates due to an applied magnetic field, the free layer extending a second distance between two ends in the track-width direction (horizontal direction in Fig. 3); a pair of magnetically hard bias layers 5, each bias layer disposed adjacent to a different one of the ends and providing a magnetic field to stabilize the magnetization of the adjacent end; and a pair of underlayers 10, each underlayer 10

disposed adjacent to a different one of the hard bias layers 5 to increase alignment between the adjacent bias layer and the free layer.

As recited in claims 19 and 31, Ooshima et al show that the end forms part of a contiguous junction (see end of 4 in Fig. 3).

Ooshima et al are silent, however, regarding the dimensions recited in claims 2-3, 7, 14-15, 19, 25-27, 31 and 37.

The law is replete with cases in which when the mere difference between the claimed invention and the prior art is some range, variable or other dimensional limitation within the claims, patentability cannot be found.

It furthermore has been held in such a situation, the Applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Moreover, the instant disclosure does not set forth evidence ascribing unexpected results due to the claimed dimensions. See *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338 (Fed. Cir. 1984), which held that the dimensional limitations failed to point out a feature which performed and operated any differently from the prior art.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to arrive at the claimed dimensions in the course of routine experimentation and optimization *Gardner v. TEC systems, Inc.*, 220 USPQ 777 (Fed. Cir. 1984). The rationale is as follows: one of ordinary skill in the art would have been motivated to arrive at the claimed dimensions through the process of routine experimentation and optimization in the absence of

criticality in order to achieve a desired bit density, resistance, power consumption, MR sensitivity, size and cost as is notoriously well known in the art.

8. Claims 4-6, 14, 16-18, 26 and 28-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ooshima et al (US Pat. No. 6731479 B2) in view of Ooshima (US PAP No. 20030030947 A1).

Ooshima et al show a magnetic sensor as described above.

As recited in claim 4, 16 and 28, Ooshima et al are silent regarding whether the underlayer includes an amorphous layer and a crystalline layer.

As recited in claim 5, 17 and 29, Ooshima et al are silent regarding whether the underlayer includes an electrically conductive amorphous layer and a crystalline layer.

As recited in claim 6, 18 and 30, Ooshima et al are silent regarding whether the underlayer includes an electrically insulating amorphous layer and a crystalline layer.

As recited in claims 4, 16 and 28, Ooshima shows that the underlayer includes an amorphous layer 32 and a crystalline layer 33.

As recited in claims 5, 17 and 29, Ooshima shows that the underlayer includes an electrically conductive amorphous layer 32 ("amorphous conductive layer", see ¶ 0139) and a crystalline layer 33.

As recited in claims 6, 18 and 30, Ooshima shows that the underlayer includes an electrically insulating amorphous layer ($Al_2O_3$, see ¶ 0139) and a crystalline layer 33.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the underlayer of Ooshima et al include a conductive or electrically insulating amorphous layer and a crystalline layer as taught by Ooshima. The rationale is as follows: one of

ordinary skill in the art would have been motivated to achieve desired epitaxial properties of the longitudinal hard biasing layer while avoiding influence from epitaxy of the antiferromagnetic layer as taught by Ooshima (see ¶ 0021-0022) and as is notoriously well known in the art.

As recited in claims 14 and 26, Ooshima et al are silent regarding whether the underlayer has a thickness that substantially aligns the magnetically hard layer and the magnetically soft layer.

As recited in claims 14 and 26, Ooshima shows that the underlayer has a thickness that substantially aligns the magnetically hard layer and the magnetically soft layer (see ¶ 0112).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to select a thickness of the underlayer of Ooshima et al such that the magnetically hard layer and the magnetically soft layer are substantially aligned as taught by Ooshima. The rationale is as follows: one of ordinary skill in the art would have been motivated to allow each magnetically hard layer to face each side of the magnetically soft layer with a sufficient volume taught by Ooshima (see ¶ 0112, "hard bias layer 34 formed with interposition of the amorphous layer may be formed by being lifted up in both side areas 20a of the projection 20c of the resistive multilayer 20, thereby allowing each hard bias layer 34 to face each side of the free magnetic layer 29 with a sufficient volume").

***Allowable Subject Matter***

9. Claims 9-10, 21-22 and 33-34 are allowed.

10. Claims 8, 11-12, 20, 23-24, 32 and 35-36 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Response to Arguments***

11. Applicant's arguments with respect to independent claims 1, 13, 25, 37, 40 and their dependent claims 2-7, 14-19 and 26-31 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Hasegawa et al (US Pat. No. 6714388 B2) teach that "an angle θ1 of inclination of the side face 8a of the multilayer film 8 is decreased in order to stabilize the magnetic coupling between the free magnetic layer 6 and the ferromagnetic layers 9" (see col. 2, lines 36-41).

Terunuma (US Pat. No. 6636395 B1) teaches that "tapered surface inclined to the medium facing surface is formed on the end face opposite to the medium facing surface of a stack comprising the free layer, the nonmagnetic metal layer, the pinned layer and the antiferromagnetic layer. A distance between the medium facing surface of the antiferromagnetic layer and the opposite face is longer than a distance between the medium facing surface of the free layer and the opposite face. Thus, a sufficient amount of heat dissipation from the antiferromagnetic layer can be ensured. Therefore, heating of the magnetic transducer can be prevented" (see abstract).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Julie Anne Watko whose telephone number is (571) 272-7597. The examiner can normally be reached on Monday through Friday, 1PM to 10PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dwayne D. Bost can be reached on (571) 272-7023. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Julie Anne Watko, J.D.
Primary Examiner
Art Unit 2627

January 17, 2007
JAW